Remarks

Favorable reconsideration and allowance of the application are respectfully requested in view of the above amendments and the following comments.

The rejection of claims 16 and 18 as unpatentable over Jensen is respectfully traversed, since the reference fails to disclose or suggest applicants' invention. Note particularly that applicants' claims require that the tool studs remain in place, within the polymer film vias formed by punching the studs through the polymer film. No such concept or process step appears in the reference. Of course, the reference is dated more than 20 years prior to the invention of the integrated circuit, further illustrating the remoteness of the reference. The rejection is therefore improper and should be withdrawn.

This application is now believed to be in condition for allowance.

Respectfully submitted,

Gary C. Honeycutt

Gary C. Honeycutt
Reg. No. 20,250
Godwin Gruber, P.C.
1201 Elm Street
Suite 1700
Dallas, Texas 75270
(214)939-8651

10. A metal matrix embossing tool, comprising a copper film having a plurality of transverse studs.

11. A device as in claim 10 whereby said studs are punch tools for forming apertures in a dielectric film.

12. A device as in claim 11 whereby said studs are equal to or slightly greater in height than the dielectric film for a flexible circuit.

13. A device as in claim 12 whereby each stud on the embossing tool is adapted to simultaneously punch and fill the vias.

14. A device as in claim 10 wherein the unraised portion of the matrix adhered to the dielectric film and attached to the studs constitutes the base metal of a plurality of solder ball contact pads for a flexible circuit.

15. A method of manufacturing the metal matrix embossing tool as described in claim 12 including the steps of:

a. laminating a photoresist on each major surface of a metal matrix, comprising copper in the range of 0.003 to 0.006 inches thick,

b. aligning a photomask pattern corresponding to conductive vias in a flexible circuit to the first surface, exposing both surfaces with a strong uv lamp, and developing the unexposed resist,

c. etching the exposed copper to a thickness of about 0.0005 to 0.0015 inches in the etched area.

16. (Amended) A method of manufacturing an intermediate base structure for a flex circuit including the steps of:

a) providing a flexible base polymer film having first and second surfaces and a layer of copper on the first surface.

b) providing a metal matrix embossing tool comprising a copper film having a plurality of transverse studs integral therewith; placing said tool studs in contact with said second surface;

c) applying a force to said metal matrix so that the studs of the tool punch through the copper coated polymer film, thereby creating a plurality of vias filled with the studs, and attaching the film matrix to the second side of the flex film.

d) electroplating a thin film of copper onto both sides of the copper clad flex film.

17. A die plate mechanism, to facilitate punching apertures in a flex circuit film using studs etched from a metal matrix, including a relatively thin metal plate in the range of 0.004 to 0.010 inches thick having apertures precisely matched to said studs, and a relatively thick plate having larger apertures.

18. (Amended) A method of manufacturing a flex circuit on a flexible base polymer film including the steps of:

a) superimposing an embossing tool having raised areas comprising a pattern of conductors and via corresponding to a circuit design, wherein, said raised areas are coated with a thin layer of metal, comprising copper,

b) applying heat and pressure to simultaneously emboss the film and to transfer said thin metal layer from the embossing tool to the polymer film,

c) removing the embossing tool,

d) embossing a pattern corresponding to that of the second surface of a flex circuit, and simultaneously transferring a thin layer of metal into the embossed pattern,

e) physically removing the embossing tool,

f) plating a layer of copper to fill the vias and conductor patterns on both sides of the film,

g) plating a layer of nickel and gold onto the exposed copper patterns, and

h) applying a solder mask on the surface of the film surrounding the solder ball contact pads.

19. A method of making an embossing tool as in claim 18 wherein a thin layer of loosely held copper is selectively coated onto the raised areas of said tool by treating the raised areas with a thermoplastic adhesive and exposing to a suspension of copper powder.

20. An embossing tool, as in claim 18 wherein a thin layer of loosely held copper is selectively plated onto the raised areas of said tool.

ABSTRACT

A method for the fabrication of a double-side electrical interconnection flexible circuit 200 particularly useful as a substrate for an area array integrated circuit package. A copper matrix with studs 203 is pressed through a dielectric film 201 having a copper layer on the opposite surface, thereby forming an intermediate structure for a flex circuit with self-aligned solid copper vias in a one step process. The contacts are reinforced by plating both surfaces with a layer of copper, and conventional processes are used to complete the circuit patterning.